CONSTRUCTION ELEMENT

The present invention relates to a construction element for the construction of a wall, and to a wall constructed with such elements, said element comprising an upper face, a lower face, and side faces, said construction element comprising at least one groove or mortise provided for delivering by grading a bonding agent or binder necessary for the assembling of the construction elements with one another, said groove or mortise extending on the upper face of the construction element, said construction element likewise comprising at least one protuberance or tenon, which extends on the lower face of the construction element, the mortise being arranged in such a way as to be in correspondence with the protuberance or tenon of a similar construction element so as to allow for the assembling of the construction elements.

For about 35 years the construction methods for individual houses have used a technique referred to as the "cavity wall technique". This type of wall is composed of two walls separated by a space of a few centimetres. The two walls are connected to one another by hooks.

The part of the cavity wall which is situated towards the exterior of the building is generally made of bricks (small elements) and is often referred to as the "facing wall".

The part of the cavity wall which is situated towards the interior of the building is generally made of blocks (large elements), and is often referred to as the "load-bearing wall".

The document GB 204.263 A describes a dry-stacking masonry system which requires that the construction elements do not present any dimensional tolerances. In addition to this, no adjustment of the elements is possible.

The elements described in this document are of traditional proportions (height/length <1) and comprise tenons and mortises which serve solely to position them and lock them in place. The elements are, in addition, in direct contact with one another.

A disadvantage of these elements is that they require a large number of special pieces for the wall connections, which are created in the traditional manner by crossing the masonry elements of which they are formed.

The document FR-A-1 271 506 describes construction blocks

of traditional dimensions which present grooves or mortises of which the cumulative width is close to the width of the block. The cumulative width of the mortises is overall greater than the cumulative width of the load-bearing partitions. There are no mortises above the walls, which are therefore not load-bearing. One disadvantage of the blocks described is that, for the assembly of such blocks, the quantity of bonding agent used is traditional. Another disadvantage is that, since the shape of the tenons in the mortises on the lower part of the block is intended to allow for easy forcing into the bonding agent (P and P' in Fig. 1), this results in a virtually zero floating capability of the block, which therefore means that there is practically no adjustment possible of the height or of the plumb alignment of the blocks. The blocks which can be used in the system described in FR-A-1 271 506 must have very low dimensional tolerances, or be rectified in such a way as to ensure the horizontal alignment of the elements in the wall.

The document FR-A-2 588 900 describes construction blocks and their assembly, in which there is no automatic delivery of the bonding agent, and the blocks of traditional dimensions used are necessarily without any dimensional tolerances. The mounting described on the block serves only for the fitting armature and for the bonding agent with which it is intended to be surrounded.

The system described in FR-A-2 588 900, as with the systems described heretofore, requires numerous special pieces for the connections of the walls, which are otherwise constructed in the traditional manner.

The document EP 0 651 104 B1 describes blocks of traditional proportions, which comprise tenon elements which are supported in the base of mortises (cf. Fig. 4 and Fig. 2), thus preventing any adjustment.

All the disadvantages which pertain with the systems described above are likewise present in the document EP 0 651 104 B1.

In addition to this, none of these elements are in any case intended for the construction of cavity walls. In effect, there is no provision for fitting a hook which connects the walls to one another, and the hook must therefore be placed in the joint or in the wall itself. The joint, however, is inaccessible, and the walls are of insufficient dimensions to

allow for the placement of the hook.

The quantity of human energy necessary in the construction of a building is particularly substantial during the construction of the shell, and during the construction of the walls in particular, whether this be due to the handling of the construction elements or their assembly with the aid of mortar.

The object of the present invention is to provide construction elements which will allow for substantial manufacturing tolerances to be achieved.

To this end, the invention provides for a construction element for the construction of a wall, characterised in that it comprises at least one mortise, which is associated with a load-bearing wall or partition made of the construction element, and which is arranged at a distance from the outer lateral edge of the construction element which is sufficient to prevent the bonding agent from extending beyond the edge of the element during assembly, the mortise and the tenon being dimensioned in such a way as to allow, during assembly, for a partial boxing effect which will allow for an adjustment of the alignment, of the height, and of the plumb alignment of the elements which are to be assembled.

The design concept of the construction element according to the present invention allows for a considerable amount of time to be gained in the construction of walls and, moreover, the finish of these walls is excellent. The assembly of the elements is made easier, since they embed easily and partially into one another thanks to the presence of the groove (mortise) on the upper surface of the elements, and the protuberance (tenon) on the lower surface of the elements. The dimensions of the mortise and the tenon are such as will allow for the adjustment of the elements, which facilitates the correct construction of the wall. In addition to this, the quantity of binder to be used is substantially reduced in relation to a traditional system of construction, because the binder does not extend beyond the edge, and the masonry can be erected with thin joints.

The present invention applies to the cavity wall technique as well as to simple single interior or exterior walls, load-bearing or non-load-bearing.

A first preferred embodiment of a construction element

according to the invention is characterised in that the height of the construction element is of such dimensions that an assembly upwards of construction elements forms a standard height beneath interior lintels and beneath masonry stretches beneath ceilings, and in that the weight of the construction element is less than or equal to 25 kg, and the height of the element is greater than or equal to its length.

It is recognised that the larger the masonry element is, the more it remains relatively light and easily handled, and the more rapid the construction of the wall will be.

It is also recognised that the number of horizontal joints is inversely proportional to the height of the construction element.

It is likewise recognised that the number of vertical joints is inversely proportional to the length of the construction element.

The horizontal joints between masonry elements will vary in thickness and as a function of the dimensional tolerances of these elements.

In the awareness that the vertical joint does not play an essential part in the mechanical strength of the walls, the construction element according to the invention is designed in such a way as to present the best compromise between its height, its length, and its weight in order to present the best characteristics favouring speed of assembly.

The assembly of the elements according to the invention is effected by adhesive bonding with the aid of a binder at thin joints. It is known that in order for this type of assembly to be carried out, it is necessary for elements to be used with very low dimensional tolerances.

Thanks to the ability of the element to float on the binder obtained by the interaction between the weight of the element, the dimensions and shapes of the mortises and tenons, and the fluidity of the binder, the present invention allows for the adjustment of the alignment, the height, and the plumb alignment, and therefore allows for the use of construction elements of which the manufacturing tolerances are relatively great.

The technique of forming the angles and internal walls in traditional masonry requires the masonry elements of one wall to be crossed with those of another wall in order to create one solid entity of the walls between one another. This technique requires considerable know-

how and a considerable amount of labour. In addition, if masonry elements are used which comprise mortises and tenons, the principle is known and essential for series of specific elements to be provided in order to connect the walls between one another.

According to a preferred embodiment of the invention, it is possible to make use of a technique for highly simplified realisation of angles and internal walls. In effect, the connection between the walls is created by straightforward adhesive bonding, with the aid of a binder, of one wall against another, no longer requiring any crossing of masonry elements.

A mason's hammer with a handle used during the assembly of the construction elements according to the present invention allows for the construction element to be gripped, moved, placed, and adjusted. In addition, when the element is suspended in this tool, it is automatically in a vertical position ideal for placement on the binder.

Other details and particular features of the invention can be derived from the description given hereinafter, and by reference to the appended drawings.

Fig. 1 shows a perspective view of a preferred embodiment of a construction element according to the present invention.

Fig. 2 shows a perspective view of another embodiment of a construction element according to the present invention.

Fig. 3 shows a perspective view of a third embodiment of a construction element according to the present invention.

Fig. 4 shows a face view of a construction element used for butt ends.

Fig. 5a shows a face view of the upper part of a construction element according to the present invention.

Fig. 5b illustrates the assembly of two elements according to the present invention.

Fig. 5c illustrates two elements of the present invention after assembly.

Fig. 6a illustrates a tool according to the present invention.

Fig. 6b illustrates a use of the tool from Fig. 5b.

Fig. 7 illustrates a full construction element according to the invention, with an accommodation point (12) for a hook.

Figs. 8 and 9 illustrate a part of a wall constructed with the aid of construction elements according to the invention.

The construction element 1 represented in Fig. 1, Fig. 2, and Fig. 3 is hollow, i.e. it is, for preference, pierced horizontally from one side to the other, its two lateral faces therefore presenting an aperture. In a preferred embodiment, the construction element likewise comprises one or more internal vertical and/or horizontal partitions.

A mortise 5 is arranged on the upper face 2, above the wall 24 or load-bearing partition 25 of the construction element 1, and the width of the mortise is for preference less than the thickness of the wall 24 or load-bearing partition 25. The mortise is located sufficiently distant from the upper longitudinal edge 6 of the construction element in such a way as to avoid, during the assembly of the construction elements, the binder extending beyond the outer edge of the elements. For example, with an element with a thickness of 14 cm, the mortise is located at a distance of 1.4 cm from the edge. This allows for exploitation in its entirety of the quantity of binder necessary for assembly, while still carrying out clean and careful work. In a particular embodiment, if it is intended that the element is to be used for the construction of a non-load-bearing wall, it can be provided with mortises and tenons which can be offset or partially offset in relation to the walls or partitions of the element, and therefore extend partially or wholly above the aperture 7.

The construction element according to the invention likewise comprises a tenon 6 intended to engage in the mortise 5 when two construction elements are arranged one on top of the other. The tenon is located on the lower face 3 of the construction element. The mortise and the tenon are of such dimensions as to allow, during assembly, partial engagement which will allow for an adjustment of the alignment, the height, and the plumb alignment of the elements which are to be assembled. To this end, the width of the tenon is slightly less than the width of the mortise.

The tenon 6 and the mortise 5 have a cross-section which is approximately trapezoidal, as illustrated in Fig. 1. Their lateral flanks extend approximately parallel to one another and the small base of the trapezoid of the tenon is arranged opposite the small base of the trapezoid of the mortise when they are engaged (Fig. 5). The said lateral flanks are

arranged in such a way as to allow for a first space between them, intended for the displacement of the binder 17 when one element is placed on another. The small bases are arranged in such a way as to allow for a second space between them, intended to be filled by the binder 17.

The depth of the mortise 5 and the height of the tenon 6 of the construction element are approximately equal and proportional to the dimensional tolerance which is to be accommodated. The ratio of the weight of the construction element on the surface of the small base of the trapezoid of the tenon is inversely proportional to the fluidity of the binder 17.

According to another embodiment of a construction element according to the invention, the mortise overlaps several walls and/or partitions of the construction element. This mortise is therefore associated with several walls or load-bearing partitions distributed over the thickness of the block.

With the aim of constructing a wall, the assembling of construction elements according to the present invention is carried out with the aid of a binder which is first placed on a palette. The mason supports the palette flat on the element on which he wishes to deposit the binder, and then slides the binder with the aid of a spatula into the mortise and spreads the binder with the aid of this spatula, in such a way that the binder in practical terms does not extend above the upper face 2 of the construction element.

When the mortise of a first element is filled with binder and a second element is placed above it, Figs. 5a, 5b, 5c, the tenon of the second element penetrates partially into the mortise of the first element. The forcing of the tenon into the mortise causes a part of the binder to go beyond the edges, via the first space between the lateral flanks of the trapezoid shapes, outside the mortise, so forming an adhesive strip between the upper face 2 of the first element and the lower face 3 of the second element. The width of this adhesive strip, for a defined spacing (height of the element plus joint) of the horizontal lines of the masonry, will vary as a function of the inherent height of the construction elements, but will always remain sufficient to ensure the adherence of the elements to one another. The stability of the wall, without ever having any overflow of binder outside the construction element, is likewise assured due to the

interaction between the mortises, tenons, and binder. Among other things, it is thanks to the fact that the mortise is offset in relation to the edge that there is no overflow of the binder. The mortise therefore serves not only to guide the tenons, but also the administration of the binder. The width of the said adhesive strip will for preference be close to 90 % of the thickness of the load-bearing wall or partition of the construction element. This allows for the effect to be minimised of the impingement of the second element on the first and vice-versa, as explained hereinafter.

The dimensions of the assembly formed by the tenon and the mortise can be determined on the basis of the aforesaid properties of the mortise and tenon. The width of the adhesive strips is determined principally as a function of the cohesion of the binder and/or the effect of the impingement. If the cohesion of the binder is greater than that of the material, it is principally the effect of the impingement which will dictate the width of the adhesive strip, which for preference will be equal to 90 % of the thickness of the wall or partition. Once the width of the adhesive strip has been fixed as determined heretofore, the minimum dimensions of the mortise and tenon are determined in such a way that, after the partial engagement and therefore the sufficient expulsion of a part of the binder, the desired width of the strip is obtained, in the awareness that a part of the binder will be absorbed by the material. Since the construction elements have manufacturing tolerances, their adjustment is desirable in order for walls to be constructed correctly. The scale of this adjustment is associated with the scale of these manufacturing tolerances. In order to obtain a more significant degree of adjustment, it is sufficient to increase the height of the tenon and the depth of the mortise in proportion to one another, and, also in proportion, to reduce the width of the tenon and of the mortise, in such a way as to retain the same volume of binder expelled and therefore the same width of the adhesive strip.

The significant ability of the construction element to float on the binder contributes to the ability of the alignment to be adjusted, as well as the height and plumb alignment, and therefore contributes to the possible use of construction elements with relatively large manufacturing tolerances. A substantial ability to float results from the interaction between the fluidity of the binder used in the invention, the weight of the element, the width of the small base of the tenon, and the width of the

large base of the mortise which are present on the construction element according to the invention.

The elements of a first line of masonry and the elements of a second line of masonry superimposed on the first, do not in any situation touch in the horizontal direction, the sole contact in the horizontal direction between these lines being by way of the adhesive strips formed by the binder.

In a preferred embodiment, one advantage of the construction element according to the present invention is that it is hollow and that it presents at least one aperture 7 on a lateral face 4a, in such a way that the open lateral face can be adhesively bonded to a lateral face of another similar construction element. Because the element is hollow, its weight is reduced, so making it easier to handle and allowing it to be lifted by means of an instrument which for preference consists of a handle 13 which likewise serves as a mason's hammer 16, in order to be able to adjust the alignment and the height of the element as well as its plumb alignment. The handle 13 is illustrated in Fig. 6a, and its use for taking up the element is shown in Fig. 6b. This tool is profiled in such a way that the bar located beneath the handle can be slid into the empty part 7 of the construction element, as shown, for example in Fig. 6b.

The construction element according to the present invention can equally be solid, if its weight or its format allow this. Fig. 7 shows an embodiment of a full construction element according to the present invention. This comprises, for preference, a mounting 12 provided to accommodate a connecting hook which will allow the facing wall constructed with these construction elements to be connected to the load-bearing wall.

The construction element according to the present invention can be manufactured from different compositions depending on the use to which it is to be put. For example, in the case of the construction of a rendered wall, the construction element may be formed from concrete, allowing for relatively lightweight elements to be obtained. This allows for elements to be proposed such that their numbers per unit of surface area are reduced in relation to traditional blocks.

Apart from this, a substantial increase in the height of the construction element has been achieved. An increase in the height of the

construction element incurs a reduction in the number of horizontal lines of masonry. In addition to this, in the awareness that the vertical joint will not be filled, this allows for an extremely significant advantage in the quantity of the binder and in terms of labour to be achieved. This increase in height inverts the traditional height/length ratio < 1 of the construction elements. Likewise, the higher the element is, the easier the adjustment of its plumb alignment becomes. For preference, the weight of the construction element is less than or equal to 25 kg and its height is greater than or equal to its length. However, the present invention also applies to elements with traditional weights and proportions, i.e. of which the weight is less than or equal to 25 kg, and their height may be less than or equal to their length.

The height of the construction element is for preference a module of the standards of heights beneath interior lintels and the stretch of walls beneath ceilings, which will avoid the elements needing to be cut and so gaining considerable amounts of time during the carrying out of the masonry work.

In an embodiment of the construction element according to the invention, such as is illustrated in Fig. 3, the mortise 5 of the construction element is provided with a void 20 to accommodate a simple or straddled metallic fitting so as to allow for the connection between two fittings, while minimising the quantity of binder necessary for enrobing them. The construction element according to the present invention can therefore likewise be used for reinforced construction formats.

In a preferred embodiment, the construction element according to the invention likewise comprises an alignment reference shaping 9, which then serves to assemble opposing joints of the said construction element with other similar construction elements. In this way it is very easy to place the construction element in such a way as to obtain an alternating alignment of the vertical joints of the construction elements when a wall is constructed with an "opposed joints" arrangement.

The construction element according to the invention can likewise comprise at least one false horizontal joint 10 and/or vertical joint 11 (Fig. 7) in the shape of a rounded half-shank. This configuration of false joints allows for the joint to be contracted at its ends, which accordingly retains the binder serving to provide the jointing.

In a preferred embodiment, the construction element according to the present invention is manufactured from concrete of which the preferred composition is as follows, for one cubic metre :

Cement :	175 kg
Crushed expanded 4/8 clay :	600 l
Crushed expanded 0/4 clay :	700 l
Sand :	70 kg

This type of concrete has the following characteristics: Its dry volumetric mass is 870 kg/m3 and its compression strength on cubes of 5 cm per side is > 4 N/mm2.

It is understood that other compositions can be used to manufacture the construction element, with the aim being to obtain a construction element which can easily be handled and which has sufficient mechanical strength for it to be capable of being used in the construction of an individual house or for other masonry works. It is possible, for example, to add expanded polystyrene fragments to the concrete in order to lighten it, or to add gravel to reinforce it. Provision can likewise be made to use construction elements according to the present invention, which may be manufactured with materials other than baked clay, cellular concrete, etc.

The binder used in a preferred embodiment of the present invention is a binder which hardens very quickly once it has been applied. At the time of the assembling of the elements, this binder penetrates to about 30 % of its volume into the material of the construction elements. The rapid hardening of this binder is incurred by a chemical reaction associated with a first transfer of water from the binder towards the elements. This results in a stability of the wall and an adherence between the elements which are very substantial after a few minutes, which allows for walls of considerable height to be built without ever being obliged to wait until the binder takes, and therefore allows for work to be carried out without stopping.

The preferred binder used for the assembling of the construction elements according to the invention has the following properties :

- Compression strength which is greater than that of the construction element itself, for preference 15 N/mm2;

- An adherence strength of at least 2 N/mm2, for preference 2.3 N/mm2;
- A density of 1.8 kg/l, and
- A ratio of water to cement of 0.45 l/kg.

The mason prepares the binder in a bucket, mixing it carefully with water, and he can then apply it on an entire layer of construction elements, aligned along the length of a guidance device, then places a layer of construction elements on top, and so on. In addition to this, because the binder is thixotropic, it is sufficient to remix it for a few minutes in the bucket in order to render it fluid once again, if necessary.

In the process of construction of a wall such as is described in the present invention, the quantity of binder necessary is about 20 times less than the quality of mortar habitually used in traditional construction procedures.

Figs. 8 and 9 show a part of a wall constructed with the aid of construction elements according to the invention. The part of the wall can be constructed either by assembling several construction elements beforehand, in such a way as to form only one single construction element, or in a single operation during the manufacture of the construction elements.

In the prior art, it was known that the internal wall is connected by engagement in the main wall. In the same way as for creating corners, the masonry is embedded. This is not necessary thanks to the performance values of the binder used in the present invention, which interact with the characteristics of the construction element of the present invention. In effect, this allows for walls to be adhesively bonded against one another without embedding. In addition to this, if the elements are provided with tenons and mortises, it is no longer essential to have special construction elements available in order for these masonry structures to be achieved.

The construction element represented in Fig. 4 is used essentially for butt ends, since it presents a full lateral wall, which allows for the header of a wall to be ended by a closed face.

Other advantages of the construction of a wall such as described in the present invention are, for example, the accommodation of the manufacturing tolerances of the construction elements. The construction elements are in fact generally manufactured in batches in a

mould. Not all the elements of the same batch will be perfectly identical. In addition, in accordance with the amount of use, the mould will be subjected to wear and will produce construction elements of which the dimensions will change. These manufacturing tolerances, which are unavoidable, do not present a problem, because they are easily accommodated in the process of the construction of walls according to the invention.